(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 937 904 B1

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
11.12.2002 Bulletin 2002/50

(51) Int Cl.[7]: **F16D 48/06**

(21) Application number: **99102723.6**

(22) Date of filing: **18.02.1999**

(54) **Vehicle with automatically controlled clutch**

Fahrzeug mit automatisch gesteuerter Kupplung

Véhicule à embrayage commandé automatiquement

(84) Designated Contracting States:
DE FR GB

(30) Priority: **23.02.1998 JP 5886898**

(43) Date of publication of application:
25.08.1999 Bulletin 1999/34

(73) Proprietors:
- **ISUZU MOTORS LIMITED**
  Shinagawa-ku, Tokyo 140 (JP)
- **Transtron Inc.**
  Kawasaki-shi, Kanagawa (JP)

(72) Inventors:
- **Masahiko, Hayashi, Isuzu Motors Limited**
  Fujisawa-shi, Kanagawa (JP)
- **Kazuhiko, Kobayashi**
  Nakahara-ku, Kawasaki-shi, Kanagawa (JP)
- **Hiroyuki, Arai**
  Nakahara-ku, Kawasaki-shi, Kanagawa (JP)

(74) Representative: **Roth, Ronald**
Patentanwalt,
Altostrasse 6
81245 München (DE)

(56) References cited:
US-A- 4 911 275

- **PATENT ABSTRACTS OF JAPAN vol. 006, no. 076 (M-128), 13 May 1982 (1982-05-13) & JP 57 015024 A (MITSUBISHI ELECTRIC CORP), 26 January 1982 (1982-01-26)**
- **PATENT ABSTRACTS OF JAPAN vol. 009, no. 326 (M-441), 21 December 1985 (1985-12-21) & JP 60 157930 A (FUJI JUKOGYO KK), 19 August 1985 (1985-08-19)**

EP 0 937 904 B1

Printed by Jouve, 75001 PARIS (FR)

Description

2. Technical Field

[0001] This invention relates to a vehicle with an automatically controlled clutch, in which ON-OFF of the clutch is automatically controlled through commands from the controller.

3. Background Art

[0002] Usually, vehicles are equipped with a friction clutch as a clutch itself and, in some vehicles, the clutch is not controlled by manual operation but is automatically controlled through signals output from a cotroller or is controlled either maually or automatically. In this specification, vehicles which allows the clutch to be controlled at least automatically are referred to as vehicles with an automatically controlled clutch.

[0003] Fig. 5 is a block diagram showing a conventional vehicle with an automatically controlled clutch. In Fig. 5, numeral 1 designates a gear lever, 2 a clutch controlling change switch, 3 a brake switch, 3A a parking brake switch, 4 a brake pedal, 4A a parking brake, 5 a controller, 5-1 a clutch ON-Off map to be applied while coasting, 6 a clutch pedal sensor, 7 a clutch pedal, 8 a master cylinder, 9 an accelerator pedal depression amount sensor, 10 an accelerator pedal, 11 an engine, 12 an engine rotation sensor, 13 a clutch, 14 a gear shift position sensor, 15 a release fork, 16 a transmission, 17 a transmission rotation sensor, 18 a pressure oil pipe, 19 a hydraulic clutch actuator, 20 a sleeve cylinder, 21 a rod, and 22 a clutch pedal position sensor.

[0004] Additionally, the vehicle with an automatically controlled clutch illustrated here enables one to control the clutch either maually or automatically.

[0005] The brake switch 3, parking brake switch 3A, clutch pedal position sensor 6, and accelerator pedal depression amount sensor 9 respectively detect whether corresponding pedals are operated or not, or detect the amount of depression of corresponding pedals. The detected signals are input to the controller 5.

[0006] The gear shift position sensor 14 detects the position of gear shift in the transmission 16, and the clutch position sensor 22 detects the clutch position between ON and OFF positions(clutch stroke). The transmission rotation sensor 17 detects rotation number of the counter shaft of the trnsmission 16. Vehicle speed can be determined by converting the rotation number taking into consideration gear ratio and the like. (In this case, the transmission rotation sensor 17 is used as a vehicle speed sensor.) Detected signals from these sensors are also input to the controller 5. The controller 5 is constituted based on computer technology.

[0007] The hydraulic clutch actuator 19 is an actuator which controls ON-OFF of the clutch based on the control signal output from the controller 5. The clutch 13 is constituted so that it can be either automatically controlled through the signal from the controller 5 or manually controlled by means of the clutch pedal 7. For this purpose, the hydraulic clutch actuator 19 is positioned on the way of the hydraulic pipe 18 between the master cylinder 8 of the clutch pedal 7 and the sleeve cylinder 20 of the clutch 13.

[0008] The clutch controlling change switch 2 is a switch which is switched on the side of the mode of automatically controlling the clutch 13 or on the side of the maually controlling mode (through the clutch pedal 7). When the switch 2 is on the side of the manually controlling mode, hydraulic pressure generated from the action of the clutch pedal 7 is conducted to the sleeve cylinder 20. When on the side of the automatically controlling mode, a pump and the like (not shown) inside the hydraulic clutch actuator 19 are co-operated by the signal output from the controller 5, and the hydraulic pressure thus generated is conducted to the sleeve cylinder 20. (In this case, even when the clutch pedal 7 is footed, no hydraulic pressure is conducted to the sleeve cylinder 20.)

[0009] Additionally, some vehicles with the automatically controlled clutch have a gear lever 1 having a switch within its knob. The switch functions so that, when a driver applies pressure to the gear lever 1 for shifting the gear, it is switched on to detect the intention of the driver. When the ON signal of the switch is input to the controller 5, the clutch 13 is let out (OFF) in preparation for gearing, then the gear is actually shifted.

[0010] When such vehicles with an automatically controlled clutch parking on a downhill road (the engine rotating with the clutch OFF) with the gear shift position being in a driving position and not in a neutral position are released from brake-parked state, they start going downhill even without stepping on the accelerator pedal 10. As the vehicle speed reaches the preset level value (=preset level value for switching the clutch ON), the clutch 13 is switched ON according to the signal from the controller 5, thus engine brake beginning functioning. As a result, the vehicle speed is decreased.

[0011] If the engine brake is so strong that the vehicle speed is decreased to another preset level (=preset level value for switching the clutch OFF), the clutch 13 is switched OFF. Otherwise, the engine could stop in some cases.

[0012] Driving without stepping on the accelerator pedal 10 (i.e., depression amount of the accelerator pedal= 0 %) is called coasting. In order to control the clutch during coasting, vehicles with the automatically controlled clutch have the above-described preset level value for switching the clutch ON and the preset level value for switching the clutch OFF, with some hysteresis between the two ON and OFF level values.

[0013] Fig. 2 is a graph illustrating the hysteresis in controlling ON-OFF of the clutch. When vehicle speed of a vehicle with the clutch off is increased to the clutch-ON level V_2, the clutch is switched ON. When vehicle speed of a vehicle with the clutch on is decreased

to the clutch-OFF level value V, the clutch is switched OFF.

[0014] The difference between the clutch-OFF level value V_1 and the clutch-ON level value V_2, H, is a width of hysteresis. If the hysteresis width is too narrow, ON-OFF of the clutch will be repeated too often. That is, so-called "clutch ON-OFF hunting" takes place. To avoid this, width of the hysteresis is generally adjusted to be large enough.

[0015] Such clutch-OFF level values and clutch-ON level values are preset for respective gear stages for controlling the clutch during coasting. They are provided in the controller 5 as a map 5-1 for switching the clutch ON or OFF during coasting.

[0016] Fig. 3 is a graph showing a conventional map for switching the clutch ON or OFF during coasting, with the gear stage as abscissa and the vehicle speed as ordinate. Curve (a) shows vehicle speed on the way of increasing at which the clutch is switched ON and Curve (b) shows vehicle speed on the way of decreasing at which the clutch is switched OFF. The difference between the curves (a) and (b) in the ordinate direction represents the hysteresis width.

[0017] To describe the clutch control specifically taking the case where a vehicle is driven in a coasting state with the gear stage at the 4th stage, the clutch will be switched ON when the vehicle speed increases to point A, whereas the clutch will be switched OFF when the speed decreases to point B.

[0018] Additionally, as conventional literature relating to the vehicle with automatically controlled clutch, there is illustrated, for example, Japanese Unexamined Utility Model No.H6-8825.

[0019] However, there has been a problem that, if the clutch OFF level value is set at a lower level in order to widen the hysteresis width for avoiding the clutch ON-OFF hunting as much as possible during coasting, the above-described conventional vehicles with automatically controlled clutch cannot be smoothly stopped.

[0020] More detailed description of the problem is as follows. In setting the clutch OFF level value at a lower level for widening the hysteresis width, the engine would stall if the level will be lower than the minimum vehicle speed for keeping the idling of engine, thus naturally the level not being set at a level lower than that. However, it is possible to set the level at an extremely near level larger than that.

[0021] If the clutch OFF level is set at such a low level, the clutch will not be easily switched OFF when the brake pedal 4 is stepped on to stop the vehicle, thus the vehicle continuously receiving the driving force of engine to keep moving. Therefore, a strong stepping force on the brake pedal 4 must be kept to stop the vehicle at an intended stopping position, thus smooth stopping having been impossible.

[0022] Independent claim 1 is based on a clutch control system as disclosed in JP-A-60 157 930.

[0023] The subject of the present invention is to solve the above-described problem.

4. Diclosure of Invention

[0024] The first subject of the invention is to avoid clutch ON-OFF hunting while a vehicle with an automatically controlled clutch are coasting. The second subject of the invention is that upon stopping the vehicle by stepping on the brake pedal, the clutch is switched OFF earlier to cut the driving force of engine and the vehicle can be stopped smoothly.

[0025] In order to solve the aforesaid subjects, it is intended in the present invetion that, in a vehicle equipped with a gear position sensor, a vehicle speed sensor, a brake switch, an accelerator pedal depression amount sensor, a vehicle-controlling controller, and a friction clutch automatically controlled to be engaged (ON) or disengaged (OFF) through the controller, the controller has two kinds of clutch ON and OFF switch maps with different hysteresis widths defining the on and off switch points of the clutch while coasting in dependence on vehicle speed and gear position to be applied for controlling the clutch while coasting, one map with a smaller hysteresis width intended to be applied while stepping on a brake pedal during coasting and the other map with a larger hysteresis intended to be applied while not stepping on a brake pedal.

5. Brief Description of the Drawings

[0026]

Fig. 1 is a flow chart which illustrates clutch control of the present invention during coasting.
Fig. 2 is a graph which shows hysteresis in controlling ON-OFF of clutch.
Fig. 3 is a graph which shows a conventional clutch ON-OFF map to be applied during coasting.
Fig. 4 is a graph which shows the clutch ON-OFF map of the present invention with a larger hysteresis width to be applied during coasting.
Fig. 5 is a block diagram which shows a conventional vehicle with an automatically controlled clutch.

6. Best Mode of Carrying Out of the Invention

[0027] The present invention will now be described in more detail by reference to the drawings.

[0028] The block diagram of the vehicle of the present invention with an automatically controlled clutch is the same as shown by Fig. 5, except that two kinds of maps are provided as the clutch ON-OFF map 5-1 to be applied during coasting. That is, one map has a smaller hysteresis width, and the other has a larger hysteresis width. It may also be possible to use a conventionally used map as a map with a smaller hysteresis width and newly provide a map with a larger hysteresis width.

[0029] Fig. 4 is a graph showing the clutch ON-OFF

map of the present invention having a larger hysteresis width to be applied during coasting. In comparison with that shown in Fig. 3, the gap between the curves (a) and (b) in the ordinate direction is larger, which means that the hysteresis width is larger.

[0030] Fig. 1 is a flow chart illustrating how to control the clutch during coasting according to the present invention. This is control is conducted within the controller 5.

Step 1···Check whether the vehicle is under coasting or not (i.e., being driven with 0 % of accelerator pedal depression amount or not) and, if not, return to the start. This is checked based on the detection signal from the accelerator pedal 10, the detection signal from the transmission rotation sensor 17 (utilizing as a vehicle speed sensor), and the like.

Step 2···Check whether the brake pedal 4 is stepped on or not. This is checked based on the detection signal from the brake switch 3.

[0019]

Step 3 ···If the brake pedal 4 is not stepped on, the clutch ON-OFF control is conducted by applying the clutch ON-OFF map for coasting with a larger hysteresis width. Thus, clutch ON-OFF hunting can be avoided. Since the brake pedal 4 is not stepped on, the driver does not want to stop the vehicle. Therefore, even when the vehicle speed is as slow as immediately before stopping, it does not matter that the clutch is in the ON state and the vehicle receives the driving force from the engine.

Accordingly, the lower limit of the hysteresis width may be slightly larger than the vehicle speed corresponding to idling rotation.

Step 4 ··· If the brake 4 is stepped on, the clutch ON-OFF control is conducted by applying the clutch ON-OFF map for coasting with a smaller hysteresis width. Since the brake pedal 4 is stepped on, the driver wants to stop the vehicle. In such a case, application of the map with the smaller hysteresis width causes earlier clutch OFF operation, thus coasting by the driving force of engine not being continued for a long time. Thus, it is not necessary to keep a strong stepping force on the brake pedal 4 till immediately before the vehicle being stopped at the intended position.

[0031] Additionally, in the above-described embodiment, description has been given taking the vehicle whose clutch can be controlled either manually or automatically as the vehicle with an automatically controlled clutch but, needless to say, the same applies to vehicles whose clutch can be only automatically controlled.

Claims

1. Automatic clutch control system for a vehicle comprising ; a gear position sensor (14), a vehicle speed sensor (17), a brake switch (3), an accelerator pedal depression amount sensor (9), all connected to a vehicle-controlling controller (5), and a friction clutch (13) automatically controlled to be engaged (ON) or disengaged (OFF) through the controller, in which the controller has two kinds of clutch ON and OFF switch maps (a,b) with different hysteresis widths defining the ON and OFF switch points of the clutch while coasting independence on vehicle speed and gear position to be applied for controlling the clutch while coasting, one map with a smaller hysteresis width intended to be applied while stepping on a brake pedal during coasting and the other map with a larger hysteresis intended to be applied while not stepping on a brake pedal.

Patentansprüche

1. Automatisches Kupplungssteuersystem für ein Fahrzeug, mit einem Getriebepositionssensor (14), einem Fahrzeuggeschwindigkeitssensor (17), einem Bremsschalter (3), einem Sensor (9) zum Erfassen des Ausmasses der Betätigung eines Fahrpedals, wobei alle diese Sensoren mit einer fahrzeugsteuernden Steuereinrichtung (5) verbunden sind, und einer Reibungskupplung (13), die durch die Steuereinrichtung automatisch in Eingriff (EIN) oder außer Eingriff (AUS) gesteuert wird, wobei die Steuereinrichtung zwei Arten von Kupplungs-EIN- und -AUS-Schaltkennfeldern (a, b) hat, die unterschiedliche Hysteresebreiten, die die EIN- und AUS-Schaltpunkte der Kupplung während des Fahrens ohne Fahrpedalbetätigung in Abhängigkeit von der Fahrzeuggeschwindigkeit und der Getriebeposition definieren, aufweisen und die zur Steuerung der Kupplung während des Fahrens ohne Fahrpedalbetätigung einzusetzen sind, wobei ein Kennfeld mit einer kleineren Hysteresebreite dafür vorgesehen ist, während der Betätigung eines Bremspedals während des Fahrens ohne Fahrpedalbetätigung eingesetzt zu werden, und das andere Kennfeld mit einer größeren Hysterese dafür vorgesehen ist, eingesetzt zu werden, wenn das Bremspedal nicht betätigt wird.

Revendications

1. Système de commande automatique d'embrayage pour un véhicule, comprenant une sonde (14) pour position d'engrenage, une sonde (17) de vitesse de véhicule, un commutateur (3) de frein, une sonde (9) pour détecter la quantité de dépression d'une pédale d'accélérateur, toutes les sondes étant connectées avec un contrôleur (5) commandant le véhicule, et une embrayage (13) à friction comman-

dée automatiquement par le contrôleur pour être engagé (ON) or être désengagé (OFF), dans lequel le contrôleur a deux types de diagrammes caractéristiques (a, b) de mettre en et hors de fonction l'embrayage, les diagrammes caractéristiques ayant différents largeurs d'hystérésis définissant les points de mettre en et hors fonction l'embrayage pendant marchant, sans appuyer sur la pédale d'accélérateur, dépendant de la vitesse du véhicule et de la position d'engrenage, les diagrammes caractéristiques avec différent hystérésis étant destiné à être appliqués pendant marchant sans appuyer sur la pédale d'accélérateur, un diagramme caractéristique avec un hystérésis plus petit étant destiné à être appliqué quand appuyer sur une pédale de frein pendant que marchant sans appuyer sur la pédale d'accélérateur, et l'autre diagramme caractéristique avec un hystérésis plus grand étant destiné à être appliqué quand non appuyer sur une pédale de frein.

Fig. 1

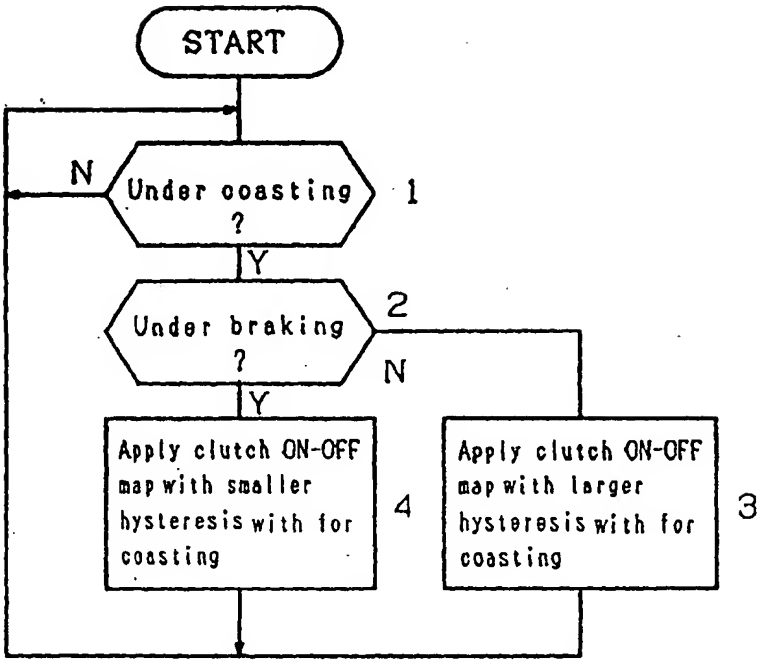

START
N
Under coasting ?
1
Y
Under braking ?
2
N
Y
Apply clutch ON-OFF map with smaller hysteresis with for coasting
4
Apply clutch ON-OFF map with larger hysteresis with for coasting
3

Fig. 2

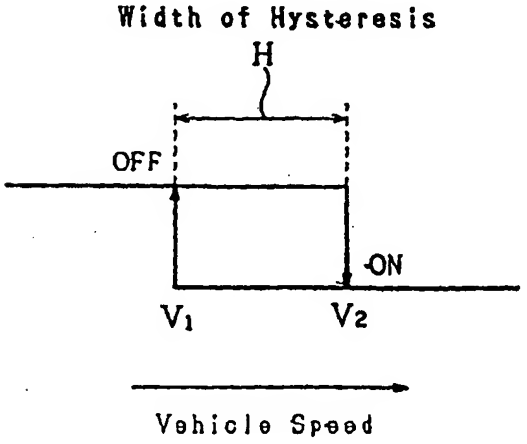

Width of Hysteresis
H
OFF
ON
V1
V2
Vehicle Speed

Fig. 3

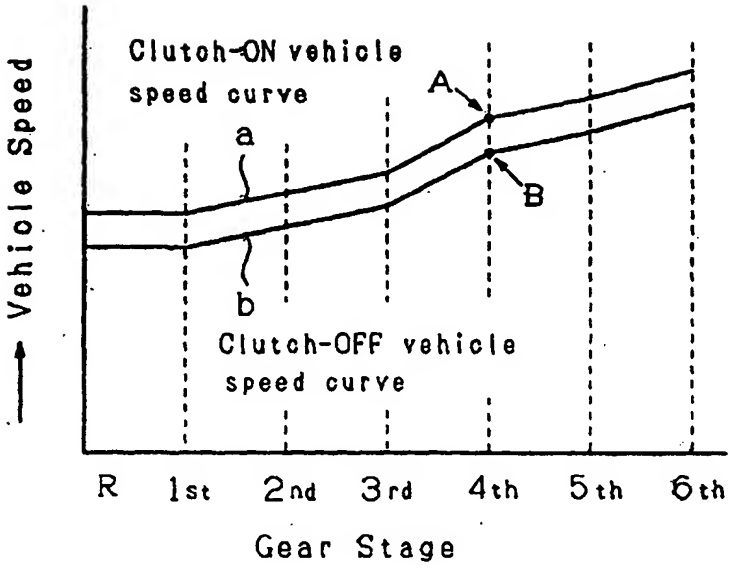

Clutch-ON vehicle speed curve
A
a
B
b
Clutch-OFF vehicle speed curve
Vehicle Speed
R
1st
2nd
3rd
4th
5th
6th
Gear Stage

Fig. 4

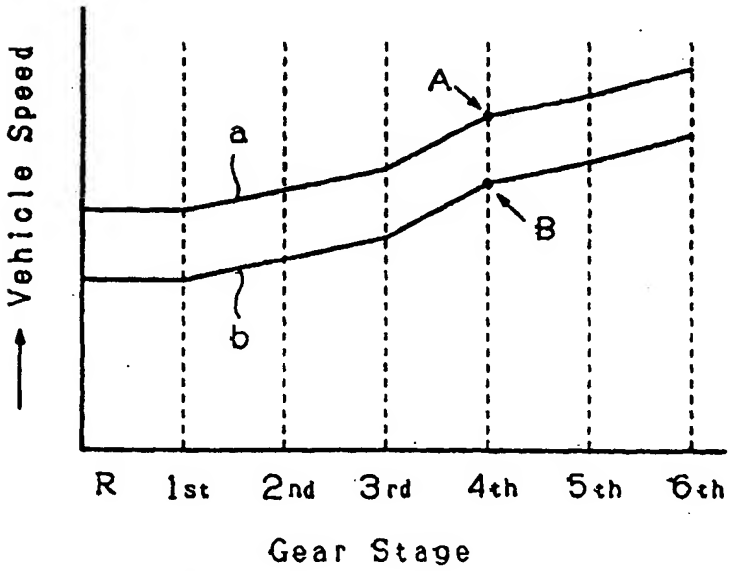
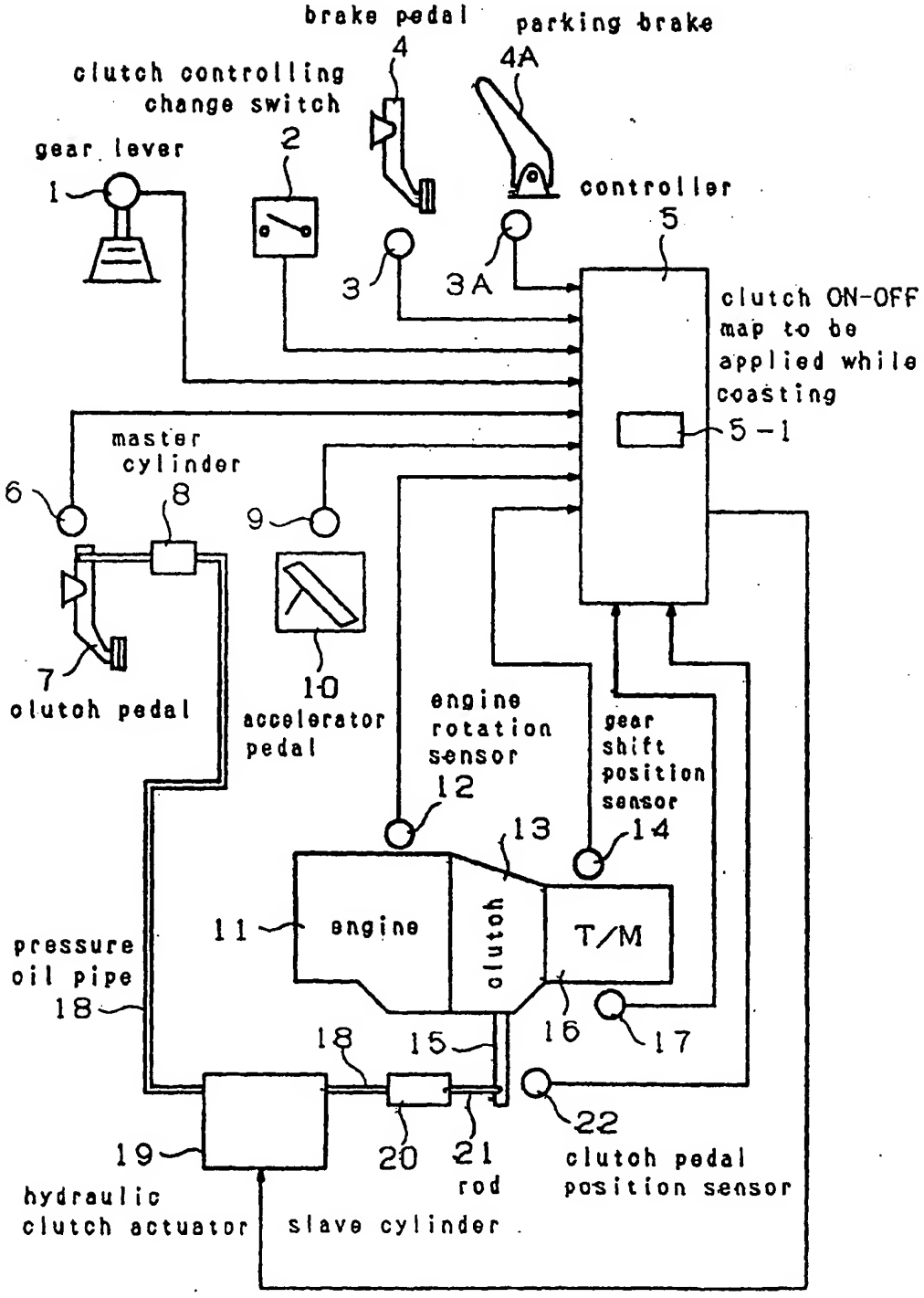

A
a
B
b
Vehicle Speed
R
1st
2nd
3rd
4th
5th
6th
Gear Stage

Fig. 5


brake pedal
4
parking brake
4A
clutch controlling change switch
2
gear lever
1
controller
5
3
3A
clutch ON-OFF map to be applied while coasting
5-1
master cylinder
8
6
9
7
clutch pedal
10
accelerator pedal
engine rotation sensor
12
gear shift position sensor
14
13
11
engine
clutch
T/M
pressure oil pipe
18
16
17
18
15
22
19
20
21
rod
clutch pedal position sensor
hydraulic clutch actuator
slave cylinder